BRUHAT BANGALORE MAHANAGARA PALIKE

Restoration and Improvements of balance roads of Chikkabettahalli village , Doddabettahalli Village, Adityanagara Phase-01 and Surrounding Areas in Ward no 03 of Yelahanka New town sub division, (Package 05), (Number of Works 02)

Detailed Project Report

August-2021

Project Cost - 1000.00 Lakhs

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CHAPTER - 1
INTRODUCTION

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Chapter -1
INTRODUCTION

1.1 Bangalore is the capital city of the southern Indian state of Karnataka. It is the seventh largest city in India. It is also known as the Garden City because of its many beautiful gardens and parks. Though the origin of Bangalore is ancient, the present-day city was founded in the 16th century and has since continued to be an important administrative center. Because of the high concentration of IT industry, it also called the Silicon Valley of India. Bangalore is rated to one of the fastest growing cities in Asia with a current population of more than 6 million. During the last couple of decades, city has witnessed drastic increase in population, change in land use pattern of the city, life style of the people and their commuting habits and the revolutionary changes that has taken place in the automobile industry. This has contributed to the growth of vehicular traffic in an enormous way.

1.2 The vehicle population in all cities in India started growing rapidly since later part of 1980s. Bangalore is no exception. It has always had a reputation of having more two wheeler users. The liberalization policy of the country made availability of not only vehicles but also loans for buying vehicles. With the rapid growth of IT sector in Bangalore, the affordability of larger segment of employees increased for ownership of vehicles, more specially two wheelers. Coupled with inadequacy of comfortable and convenient public transport gave an impetus to more and more commuters shifting to cars and two wheelers for their commuting in Bangalore. The number of registered motor vehicles has crossed 2.5 million and is growing at a rate of over 12% per annum. The two wheelers, which constitute about 72% of the total registered vehicles, are growing at a rate of about 13% per annum. Lately, cars have been growing even faster than two wheelers. Vehicle ownership has grown from 58 to 365 per 1000 population. The trend is likely to continue. This will result in higher use of personalized modes of transport particularly cars unless extensive and convenient public transport system is provided.

1.3 The combined effect of all these on the road network of Bangalore is delay and congestion beyond tolerable limits. Vehicular conflicts at the intersections are being eliminated by traffic signals but at the expense of delays and long queues. The peak hour has spread over a longer period of time, since there are no perceptible capacity augmentation / conflict reduction measures.

In view of the above facts, road commuters are experiencing inconvenience and increased road user cost due to increase in the following factors.

- Intra city commuting time.
- Traffic congestions.
- Number of junctions & intersections.
- Junction delays.
- And increased rate of accidents, health hazards etc.

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Hence, there is an urgent necessity to decongest these roads and intersections

1.4 As a comprehensive development programme for improvement of road network, the Bruhath Bangalore Mahanagara Palike (BBMP) has planned Improvements to Junction, widening / Improvements of roads, strengthening of pavement base and sub – base, improvement to pedestrian facilities, improvements to Drainage Facility, etc. This response is the answer to the severe strain on the urban infrastructure, which is inevitable due to the very rapid rate of growth in traffic. Travel demands of passengers have increased many folds in the last two decades. Unfortunately growth in the infrastructure is not commensurate with the growing demands of traffic. There is an exigent need to effectively manage the traffic and transportation systems to optimize the solutions with short term and long – term measures.

1.5 Project Location

Restoration and Improvments of balance roads of Adhityanagara Phase-01 , Chikkabettahalli village and Doddabettahalli Village and Surrounding Areas in Ward no 03 of Yelahanka Satelite town sub division. The Project area is located near Adithya nagar of Bangalore City. Major attractions along the stretch are Adhitya Nagara, Balaji Gardenia Layout, Shri Venkateshwara Temple Road, Ashwathkatte Road, MM Layout Road, Marammma Temple Surroundings. The Stretch provides vidal connectivity in Adhityanagara and Surrounding Area.

Key Map of the roads proposed is enclosed in **Annexure A.1.1**.

M/s. TEJUS CONSULTANTS is entrusted by BBMP to carrying out the work of Preparation of Detailed Estimate and Report for the above said works.

1.6 Scope of Work

The Scope of Services of the Consultancy includes the Following:

- Inventory and condition surveys for existing road & pavement, cross drainage structures and bridges.
- Identification of possible improvement of the existing alignment, central widening / one side widening etc.
- Flexible Pavement Design.
- Rate analysis of scheduled items, BOQ and cost estimates.

1.7 Contents of the Report

The Methodology, as detailed in the Project Proposal, has been followed for carrying out the necessary Investigations and Preparation of Detailed Estimate and Report.

This Report includes the following.

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- Chapter 2: Engineering Surveys and Investigation
- Chapter 3: Design Standards
- Chapter 4: Analysis, Designs and Improvements
- Chapter 5: Cost Estimates
- Chapter 6: Conclusion
- Chapter 7: Photographs
- Chapter 8: Drawings

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Restoration and Improvments of balance roads of Adityanagara Phase-01 and Surrounding Areas in Ward no 03 of Yelahanka Satelite town sub division

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KEY MAP

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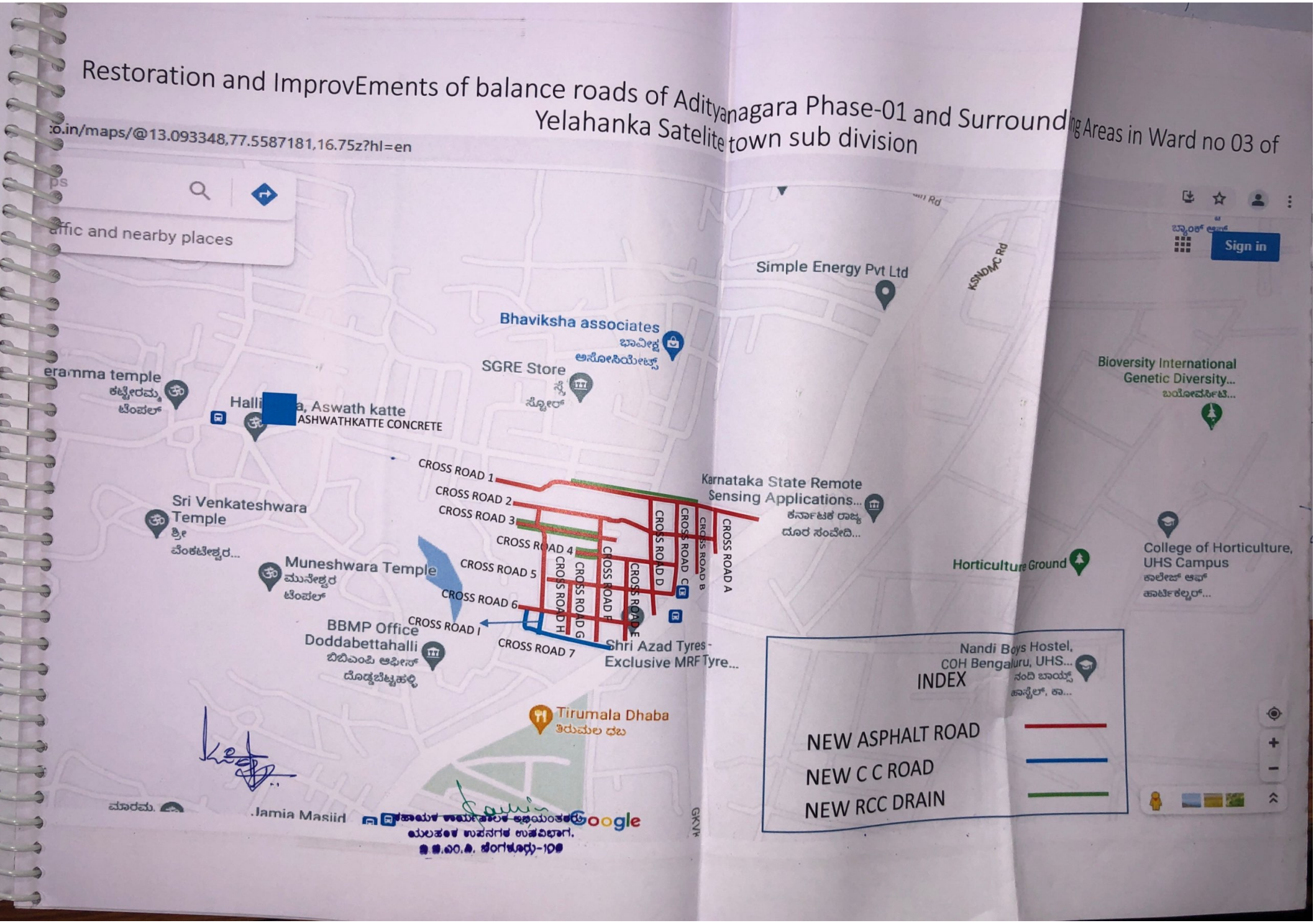
Restoration and ImprovEments of balance roads of Adityanagara Phase-01 and Surrounding Areas in Ward no 03 of Yelahanka Satelite town sub division



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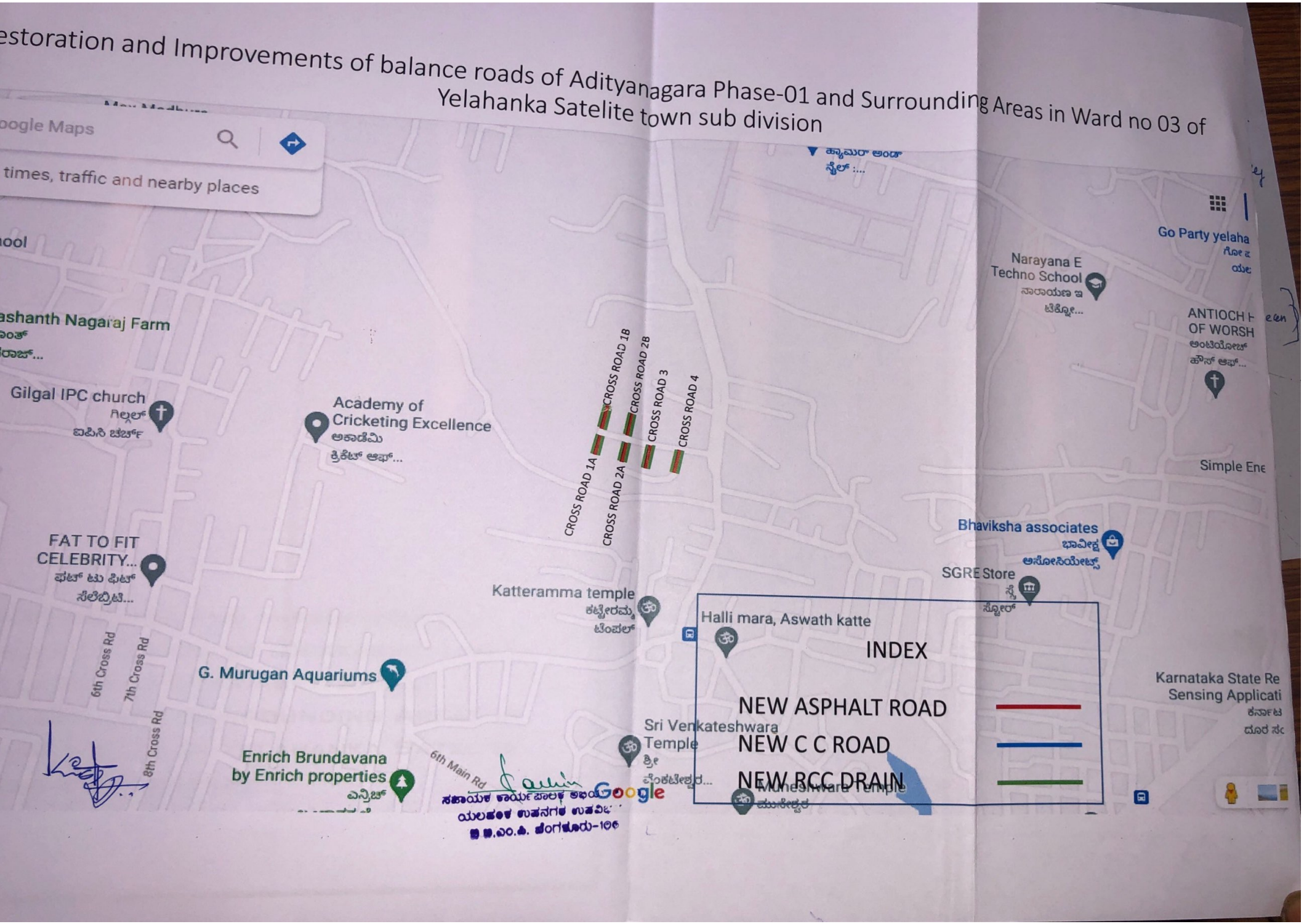

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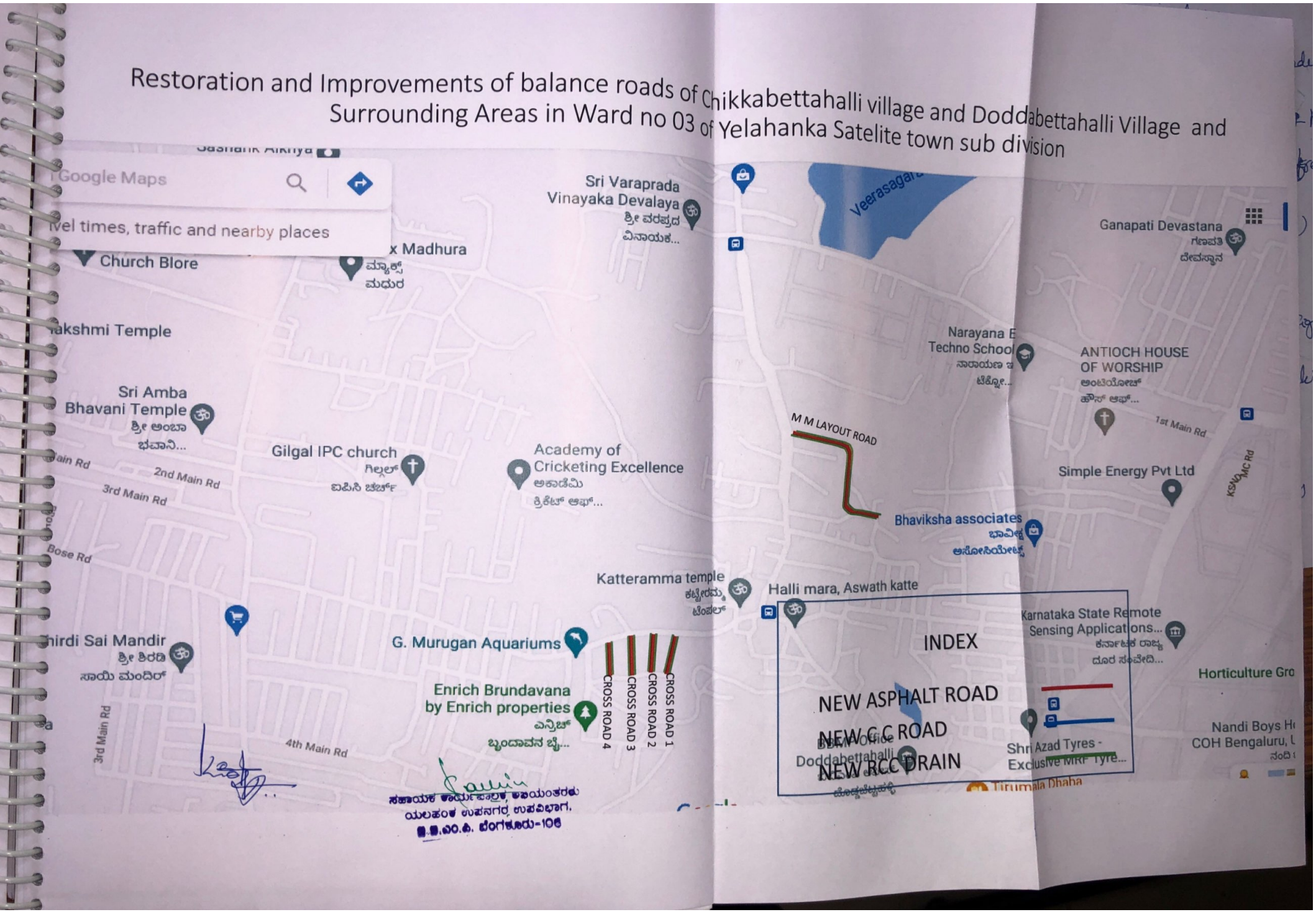

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CHAPTER -2
ENGINEERING SURVEYS AND INVESTIGATIONS

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Chapter -2
ENGINEERING SURVEYS AND INVESTIGATIONS

2.1 General

Various surveys and investigations that are essential inputs for detailed engineering design are detailed in this chapter. All the relevant maps / data / details available with the concerned departments have been collected, compiled and reviewed. Particular attention has been given to past / historical data / reports. A review of the past data available in the various studies has been listed out and such available data has been made use of, after updating / augmenting the data wherever necessary. The data as collected has been made use of in analysis, design, formulation of improvement proposals and costing. The activities have been performed on several fronts fully complying with the requirements. The activities that are carried out are succinctly brought out hereunder.

The various engineering surveys / investigations of the road sections include:

- Reconnaissance Survey.
- Visual Topographical Survey.
- Road Inventory Survey.
- Pavement Condition Survey.
    - Visual Condition Survey.
    - Geotechnical Investigation

2.2 Reconnaissance Survey

Reconnaissance Survey of the road, considered for improvements, has been carried out to identify the general condition of roads, drains, culverts and bridges for further surveys / investigations, to understand kind of establishments along the stretches of roads and to work out land acquisition scheme. Making use of the observations / data collected during reconnaissance survey, detailed schedule for surveys / investigations required for the project has been finalized.

2.3 Topographical Survey

Detailed topographic survey of the entire stretch of project road has been carried out. The topographic survey has been carried out using computerised Total Station / Auto Level equipment supported by Global Positioning System (GPS) equipment. The survey results have been recorded on a computerised

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format for use in Computer Aided Design and Drafting (CADD) to generate a three dimensional Digital Terrain Model (DTM) of the project road which is the state-of-the-art method in latest computerized design of highways. Drawing of plan and profile has been produced using Intergraph in Roads software ensuring speed and accuracy Topographical Map of the project Stretch is enclosed in **Chapter 8: Drawings.**

2.4 Road Inventory Survey

A detailed inventory and condition survey of road sections has been carried out by making use of well structured inventory data format. It was compiled in tabular form, developed using Excel computer software. Various data collected during the road inventory broadly include.

- Type of terrain.
- Land use.
- Carriageway width.
- Type of surfacing.
- Shoulder, Median, Drain (tertiary / shoulder), Footpath – type and width.
- Road Geometry.
- Road Furniture.
- Illumination.
- Salient Buildings & Structures.
- Road Intersection(s) and their details.
- Land width (RoW).
- Culverts, bridges and other structures (type, size, span arrangement, and location).
- General drainage conditions.

2.5 Pavement Condition Survey

The Pavement Condition Survey has been carried out in accordance with IRC Guidelines. All surveys and investigations have been carried out with the following objectives

- To have an up to date record of road assets.
- To have a clear understanding of road side features including land use, drainage characteristics, etc. and
- To assess the condition and strength data for developing improvement proposals and related designs.

2.5.1 Visual Condition Survey

Visual Condition Survey of the road sections has been carried out by travelling along the project road and noting down the pavement conditions such as extent of cracking, patching, rutting, pot holes, edge

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breaking, etc. by visual observations in a well structured data format. The data so collected has been compiled and presented (kilo metre wise) in the form of tables for easy understanding. This data has been used to assess the pavement condition.

2.5.2 Sub-Grade Characteristics and Strength

The data relating to soil classification and mechanical characteristics for soils along the existing alignments were collected.

For the widening of the existing road within the ROW, testing is being performed on at least three sub-grade soil samples for each homogenous road segment or three samples for each soil type encountered whichever is more.

The sub-grade soil is being tested as follows:

- In-situ density and moisture content at each test pit.
- Field CBR at each test pit.
- Characterisation (grain size and Atterberg limits) at each test pit.
- Laboratory moisture-density characteristics (modified AASHTO compaction).
- Laboratory CBR (unsoaked and 4-day soak, compacted at three energy levels) and swell.

➢ **Objective**

The objective of the investigations is to provide basis for design of various types of pavements viz. pavement option study for the project road, keeping in view the composition and characteristics of the existing pavement/sub grade. The scope of work thus includes:

- Collection of information regarding the existing pavement crust composition and characteristics.
- Existing Sub grade type and sub-soil conditions.

➢ **Methodology for Sub-grade Soil and Pavement Crust Investigations**

Test pits of approx. 1.0 m x 1.0 m size staggered along the edge of the existing pavement on both sides are excavated up to sub grade level (up to 1.5m depth) at regular intervals along the road alignment. These test pits are excavated on shoulders extending about 20 cms into the pavement.

Bulk sample of about 30kg was collected from all the test pits at natural ground level to analyze the characteristics of the existing sub grade material. Field Density tests were conducted for all the test pits and also the natural moisture content were determined at each test pits.

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The following laboratory tests were conducted for all the samples collected from the test pit.

- Grain Size Analysis (As per IS: 2720 –Part 4).
- Atterberg limits test (As per IS:2720-Part 5).
- Standard proctor tests (As per IS: 2720 - Part 8).
- Soaked CBR tests (4-days soaked).

2.6 Traffic Surveys

The programme for traffic studies and the location of traffic surveys have been finalised after reviewing in detail the available traffic data. Particular attention has been paid to identify gaps and further data requirements of the study. The traffic surveys have been designed for filling up data gaps as well as updating the information. The locations of the survey stations have been reviewed considering the suitability of various types of traffic surveys. Traffic surveys have been carried out at selected locations for updating the traffic information. Following surveys have been conducted:

- Traffic Volume Count.

These surveys have been carried out in accordance with IRC: SP – 19 – 2001 and IRC: SP – 41 – 1994. The study details of Hourly Traffic Volume Count are enclosed in **Annexure A.2.1**

2.6.1 Traffic Volume Count

For ascertaining the present traffic flows on various road stretches, classified traffic volume counts have been undertaken to ascertain the type and number of operating vehicles. Data has been analyzed to identify peak hour flows and composition of traffic. PCU factors are as per IRC: 106 – 1990 "Guidelines for Capacity of Urban Roads in Plain Areas". These field surveys carried out in a scientific manner have led to a realistic data bank based on which the design and cost of construction of the pavement is being developed. Data derived from the survey has been analyzed to identify requirements of suitable remedial measures such as junction improvements; widening of ROW; pedestrian crossings etc.

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CHAPTER -3
DESIGN STANDARDS

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Chapter -3
DESIGN STANDARDS

3.1 General

Planning and design of roads & CD structures, pedestrian facilities and street furniture are essentially based on the IRC standards and MoRT&H specifications. Whenever, the codes / standards are silent on some of the aspects, the same has been planned / designed based on sound engineering practices. Design standards relevant to the project road along with the broad list of design parameters and the relevant IRC codes / specifications have been detailed in **Table 3.1.**

Table 3.1
Design Standards

Sl. No.	Design Parameters	Reference Code
1.	**Geometric Design Standards** • Carriageway width • Shoulder • Footpath • Median • Camber • Super Elevation • Horizontal Alignment • Vertical Alignment	As per IRC: 38 – 1988, IRC: 86 – 1983 & IRC: SP : 23 – 1993
2.	**Road Furniture** • Road Delineators • Road Markings • Road Signs	As per IRC: 79 – 1981 As per IRC: 35 – 1997 As per IRC: 67 – 2001
3.	Road Capacity	As per IRC: 106 – 1990
4.	Flixible Pavement Design	As per IRC: 37 – 2012
5.	Road Drainage	As per IRC: SP: 42 – 1994 & IRC: SP: 50 – 1999
6.	Culverts	As per relevant IRC codes and MoRT&H specifications

The project road section passes through plain terrain. Design standards (as appropriate) have been further elaborated under the following heads:

- ❖ Geometric Design
- ❖ Pavement Design
- ❖ Drainage

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- ❖ Road Furniture and Appurtenances
- ❖ CD Structures

3.2 Design Standards Related to Geometric Design

Design standards related to road geometric along with the suggested design values / standards and recommended values based on site conditions and data analysis are detailed in **Table 3.2**.

Table 3.2
Geometric Design Standards

Sl. No.	Design Parameters	Design Values
1.	Design Speed	Design speed Considered is 40 kmph.
2.	Geometric Design Standards	
	• Carriageway Width	Two lane carriageway
	• Camber (Bi – directional)	2.5% for paved carriageway.
	• Super Elevation**	Limited to 4%.
	• Footpath	Minimum width – 1.5m
	• Kerb	Barrier / Semi – barrier / Mountable (Barrier type recommended)
	• Minimum Radius of Horizontal Curve	40 m for a speed of 30 kmph 105 m for a speed of 50 kmph
	• Extra Widening at Curves	Nil for Radius above 300 m
	• Gradient	Maximum Gradient – 4.0 % (1 in 25) Minimum Gradient for Drainage – 0.5 % (desirable minimum) & 0.3 % (absolute minimum).

(* - Reference Code: IRC: 86 – 1983 – "Geometric Design Standards for Urban Roads in Plains")

3.3 Design Standards Related to Pavement Design

Design standards related to Overlay design are essentially based on the guidelines given in IRC: 81 – 1997 "Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Beam Deflection Technique". The suggested design values / standards and recommended values based on site conditions and data analysis are detailed in Table 3.3. and are adapted in the design.

Table 3.3
Overlay Design Standards

Sl. No.	Design Parameters	Reference Code / Design Values
1.	Rigid Pavement Design	IRC: 81 – 1997 "Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Beam Deflection Technique"
	• Design Life	15 years

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Sl. No.	Design Parameters	Reference Code / Design Values
	• Correction Factors	Temperature Correction Factor. Correction for Seasonal Variation (inclusive of correction for moisture content, soil type and rainfall)
	• Minimum Thickness	From structural considerations recommended minimum Dry lean concrete of 150mm thick and unreinforced plain cement concrete of 300mm thick.
2.	Wearing Course Material (Options)	Unreinforced Plain Cement Concrete

3.4 Design Standards Related to Road Drainage

Drainage of water from pavement surface is of paramount importance as far as preserving the road assets created by investing huge funds in addition to maintaining the structural soundness and functional efficiency of the road. Design standards related to road drainage are essentially based on the guidelines given in IRC: SP: 42 – 1994 "Guidelines on Road Drainage" and in IRC: SP: 50 – 1999 "Guidelines on Urban Drainage". The suggested design values / standards are detailed in **Table 3.4**.

Table 3.4
Design Standards Related to Road Drainage

Sl. No.	Design Parameters	Design Values
1.	• Camber	1.7 – 2.5 % (bi – directional) for carriageway (camber of 3% is adopted).
	• Longitudinal Gradient	Minimum 0.3 – 0.5% for satisfactory drainage
	• For Existing Drains	Desilting and Rectification of Damaged Portion

3.5 Design Standards Related to Road Furniture and Appurtenances

Utility and importance of the road are greatly enhanced by installing road furniture and appurtenances at appropriate locations along the project road, which ensures improved road safety. Planning and design of road furniture and appurtenances are as per the guidelines stipulated in IRC. Detailing of each of these components has been done so as to integrate the same with the road improvement scheme. The suggested design values / standards are detailed in **Table 3.5**.

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Table 3.5
Design Standards Related to Road Furniture and Appurtenances

Sl. No.	Design Parameters	Reference Code / Design Values
1.	Road Markings	IRC: 35 – 1997 "Code of Practice for Road Markings".
2.	Road Signs	IRC: 67 – 2001 "Code of Practice for Road Signs".
3.	Road Delineators	IRC: 79 – 1981 "Recommended Practice for Road Delineators".
4.	Pedestrian Facilities	IRC: 103 – 1988 "Guidelines for Pedestrian Facilities".

In addition to the above measures various other integral road components have been planned so as to achieve the maximum and optimal use of the carriageway with no / least interference to traffic flow at the same time ensuring adequate facilities to other road users especially pedestrians. All the encroachments, if any shall be cleared within the ROW.

3.6 Specification and Design Codes

The Designs of Structural Components have been in conformation to the Criteria laid down in the Latest Editions of the following Codes of Practice and Standard Specifications.

IRC: 5	General Features of Design
IRC: 6	Loads and Stresses
IRC: 21	Cement Concrete (Plain and Reinforced)
IRC: 35	Code of Practice for Road Markings
IRC: 78	Foundation and Substructure
IRC: 83 (All Parts)	Standard Specifications and Code of Practice for Road Bridges – Bearings
IRC: 92	Guidelines for the Design of Interchanges in Urban Areas
IS: 875 (Part 3)	Code of Practice for Design Loads (Wind Load)
IS: 1893	Criteria for Earthquake Resistant Design of Structures

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CHAPTER -4
ANALYSIS, DESIGN AND IMPROVEMENTS

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Chapter - 4
ANALYSIS, DESIGN AND IMPROVEMENTS

4.1 General

Improvement proposals for an existing road section essentially consist of two components, geometric and structural improvements. Geometric improvement deals with visible dimensions of roadway, probable road widening and is dictated by the traffic and economic considerations. Due to the inherent restrictions like limitation in land acquisition, limited right of way and existing utilities / services, etc. the horizontal and vertical alignments in general follow the existing geometry except in situations where improvements are possible. The geometric improvements mainly involve improvements to cross sectional elements such as carriageway, shoulders, etc. The structural component deals with the pavement and embankment design aspects, i.e., the ability of the roads to adequately carry and support the vehicle / wheel loads over the design period. Safety, speed, efficiency, economy and comfort in traffic movement to a large extent are governed by adequacy of design standards used for a specific road facility.

The improvement proposals need to consider the method of widening like concentric or eccentric to the existing road which is dictated by site situations like available land for acquisition, curvature, existing utilities, terrain, places of worship, monuments, grave yards, places of importance etc.

This chapter deals with the analysis of data collected during various engineering surveys/investigations and the formulation of improvement proposals including planning and design.

4.2 Road Inventory and Physical Characteristics of Road Section

Investigations / studies have been carried out along the Project Stretch. Physical characteristics of these road and road Junctions are as follows.

Restoration and Improvments of balance roads of Adhityanagara Phase-01 , Chikkabettahalli village and Doddabettahalli Village and Surrounding Areas in Ward no 03 of Yelahanka Satelite town sub division. The Project area is located near Adithya nagar of Bangalore City. Major attractions along the stretch are Adhitya Nagara, Balaji Gardenia Layout, Shri Venkateshwara Temple Road, Ashwathkatte Road, MM Layout Road, Marammma Temple Surroundings. The Stretch provides vidal connectivity in Adhityanagara and Surrounding Area.

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Road Name	Length, m
Asphalt Road	
Adithya Nagara	
1st Cross Road	355.00
2nd Cross Road	260.00
3rd Cross Road	125.00
4th Cross Road	120.00
5th Cross Road	155.00
6th Cross Road	120.00
Cross road A	70.00
Cross road B	100.00
Cross road C	130.00
Cross road D	165.00
Cross road E	110.00
Cross road F	170.00
Cross road G	75.00
Cross road H	170.00
Balaji Gardenia Layout	
Main Road	145.00
Cross Road 1A	30.00
Cross Road 1B	40.00
Cross Road 2A	30.00
Cross Road 2B	35.00
Cross Road 3	30.00
Cross Road 4	35.00
Maramma temple surroundings	
cross road A	85.00
cross road C	75.00
cross road H	30.00
cross road I	245.00
cross road K	300.00
cross road M	245.00
Over Head Tank Road	360.00
cross road A2	50.00
cross road A3	40.00
cross road A4	29.00
Choudeshwari layout	
1st cross road	80.00
2nd cross road	75.00
3rd cross road	80.00
4th cross road	70.00
M M Layout	305.00
New CC Road	
Shri Venkateshwara Temple Road	155.00
Ashwathkatte Road	62

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Adithya Nagara	
cross road I	27.00
7th cross road	120.00
Marammma Temple Surroundings	
cross road A5	26.00
cross road A6	50.00
Marammma Temple Surroundings	
Cross Road N	96.00
Cross Road O	40.00
Cross Road Q	40.00
Cross Road R	30.00
Cross Road T	60.00
Cross Road U	45.00
Cross Road V	30.00
Cross Road W	35.00
Cross Road X	105.00
Total	**5460.00**

The total length of the Project Stretch is 5460.00m.

The Road carries considerable vehicular traffic throughout the day especially during peak hours. Considerable pedestrian traffic is also present along the corridor.

4.3 Summary and Recommendations

To obtain the Geotechnical and Materials characteristics of project stretch, an extensive study of the existing pavement sub-base, local borrow areas for embankment were carried out. Accordingly the entire stipulated tests have been performed and the summary of test results along with the recommendations has been attached.

- The CBR value of existing sub grade of the Road varies between 9%-11%.

4.4.1 Analysis of Traffic Data

Data was processed on hourly basis to establish the peak hours. Data collected from surveys were computerized and analysed to study hourly variation of traffic, peak hour flows, traffic composition, etc. The counts were classified by category of vehicles and by direction of movement. The various vehicle types having different sizes and characteristics were converted into equivalent passenger car units. The Passenger Car Unit (PCU) factors recommended by Indian Road Congress in "Guidelines for Capacity of Urban Roads in Plain Areas" (IRC: 106 – 1990) have been. The same are detailed in **Table 4.2.**

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Table 4.2
Recommended PCU Factors for Various Types of Vehicles on Urban Roads

Vehicle Type	Equivalent PCU Factors	
	% Composition of Vehicle type in Traffic stream	
	Up to 10%	10% and above
Fast Moving Vehicles		
Two wheelers, Motor cycle or Scooter, etc.	0.5	0.75
Passenger Car, Pick up Van	1.0	1.0
Auto-rickshaw	1.2	2.0
Light Commercial Vehicle	1.4	2.0
Truck or Bus	2.2	3.7
Agricultural Tractor Trailer	4.0	5.0
Slow Moving Vehicles		
Cycle	0.4	0.5
Cycle rickshaw	1.5	2.0
Tonga (Horse drawn vehicle)	1.5	2.0
Hand cart	2.0	3.0

(Source: IRC: 106 – 1990)

4.4.2 Design Traffic

Peak hour traffic is taken as design hour traffic for urban roads. Maximum of morning and evening peak flow is taken as design hour traffic.

4.4.3 Cumulative Standard Axles for Pavement Design

Traffic projections available from traffic study have been used for design of pavements. The design traffic is considered in terms of cumulative number of standard axles to be carried during the design life of the road. Its computations involves estimates of the initial volume of commercial vehicles per day, lateral distribution of traffic, the growth rate, the design life in years and the vehicle damage factor to convert commercial vehicles to standard axles.

The following equation is used to compute the design traffic in terms of the cumulative number of standard axles.

$$Ns = \frac{365 \times [(1+r)^n - 1]}{r} \times A \times D \times F$$

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Where,

Ns = Cumulative number of standard axles to be catered for in the design

A = Initial Traffic, in terms of commercial vehicles per day modified to account for lane distribution.

r = Annual growth rate of commercial vehicles (Growth rate adopted as per the recommendation Chapter 3).

n = Design life in years (10 years)

F = Vehicle Damage Factor

The design traffic computed in terms of cumulative number of standard axles (msa).

4.5 Pavement Design

The following guidelines have been followed for design of new pavement and for design of overlays for the existing pavements.

- AASHTO guide for design of pavement structures, 1993.
- Guidelines for design of flexible pavements IRC-37, 2001.
- IRC: 81 - 1997 Guidelines for Strengthening of Flexible Road Pavement using Benkelman Beam Deflection Technique.

4.5.1 Design of Flexible Pavement

The following inputs are considered for designing the flexible pavement as per IRC guidelines.

- Design Traffic in terms of cumulative number of standard axles (msa)
- Annual Average Pavement temperature is taken as 350C.
- Sub grade strength is considered in terms of the CBR value.

Using the design CBR value and the cumulative standard axle load, total pavement thicknesses have been obtained from the design charts given in IRC: 37-2012.

150mm Granular Sub Base shall be laid by compacting existing metal stone surface and overlaid with 200mm Wet Mix Macadam, 50mm Dense Bituminous Macadam and 40mm Bituminous Concrete.

City roads should be designed for minimum 2 msa traffic. The CBR of soil is 7% CBR (As per IRC 37 – 2012, Page No. 25, Plate 5).The composition of pavement layers from the above Detailed Design is shown in table below.

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Pavement compositions

Recommended for Surface course of 2 MSA		Recommended Base course of 2 MSA	
BC	DBM	WMM	GSB
40	50	200	150

4.6 Proposed Improvements to Road Section

The proposals for the improvement of the geometric elements of the existing project road sections generally include:

a. Road Geometry Improvements

- Maintaining Uniform Carriageway.
- Improvements to cross sectional elements.
- Provision of New Kerbs and Kerb Painting Balaji Gardenia Layout, Adithya Nagara,Marammma Temple Surroundings, Choudeshwari layout.

b. Road Drainage Improvements

- Provision of desilting of Existing Drains.
- Provision of Removing and Refixing of footpath slabs for Drain.
- Provision of New Precast slab for Missing Length
- Provision of RCC Drain in Balaji Gardenia Layout, Adithya Nagara,Marammma Temple Surroundings, Choudeshwari layout.
- Provision of New Culverts at Cross Roads.
- Provision of New 100mm Precast slab for Drain.
- Provision of 230mm Precast slab for culvert.

c. New Asphalt Road Construction/ Flexible Pavement.

Adithya Nagara (1st Cross Road, 2nd Cross Road, 3rd Cross Road, 4th Cross Road, 5th Cross Road, 6th Cross Road, Cross road A, Cross road B, Cross road C, Cross road D, Cross road E, Cross road F, Cross road G, Cross road H)

Balaji Gardenia Layout (Main Road, Cross Road 1A, Cross Road 1B, Cross Road 2A, Cross Road 2B, Cross Road 3)

Maramma temple surroundings (cross road A, cross road C, cross road H, cross road I, cross road K, cross road M, Over Head Tank Road, cross road A2, cross road A3)

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Choudeshwari layout (1st cross road, 2nd cross road, 3rd cross road, 4th cross road, M M Layout)

- Provision of 150mm Granular Sub Base
- Provision of 200mm Wet Mix Macadam
- Provision of 50mm Dense Bituminous Macadam.
- Provision of 40mm Bituminous Macadam

d. New CC Road Road Construction/ Rigid Pavement.

Shri Venkateshwara Temple Road, Ashwathkatte Road, Adhitya Nagara, Marammma Temple Surroundings,

- Provision of 150mm Dry Lean concrete-1:5:10.
- Provision of 150mm Pavement Quality Concrete-M30

e. Road Furniture and Appurtenances

- Providing Lane Marking
- Providing the moulded shank.

RIGID PAVEMENT DESIGN:

A) The rigid pavement consists of cast in-situ/ premix concrete.

The slab design method is based on assessments of the:

- Predicted traffic volume and composition over the design period
- Strength of the subgrade in terms of its California Bearing Ratio
- Strength of the base concrete
- As the roads taken for development are slushy and having low CBR value, a layer of GSB is provided as Sub Base Course.
- B) A bound of lean mix concrete sub-base is recommended under a concrete pavement for one or more of the following reasons:
- To resist erosion of the sub-base and limit 'pumping" at joints and slab edges.
- To provide uniform support under the pavement
- To reduce deflection at joints and enhance load transfer across joints (especially if no other load transfer devices are provided, such as dowels); and
- To assist in the control of shrinkage and swelling of high-volume-change subgrade soils

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Table 3.1 Approximate k Value Corresponding to CBR Values

Soaked subgrade CBR	2	3	4	5	7	10	15	20	50
k Value (MPa/m)	21	28	35	42	48	50	62	69	140

Table 3.2 Effective k Values Over Granular and Cementitious Subbases

Soaked CBR	2	3	4	5	7	10	15	20	50
k Value over granular subbase (thickness 150 to 250 mm), MPa/m	25	34	42	50	58	60	74	83	170
k Value over 150 to 200 mm cementations sub base MPa/m	42	56	70	84	96	100	124	138	280

- The composition of pavement layers from the above Detailed Design is shown in table below.

Pavement compositions

Recommended Layers, mm		
PQC	**DLC**	**Sub Base Course**
150	150	---

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Restoration and Improvments of balance roads of Adityanagara Phase-01 and Surrounding Areas in Ward no 03 of Yelahanka Satelite town sub division			
S.No	ASPHALT ROAD DETAILS		
	ROAD NAME	ASPHALT ROAD	
		Length in M	Width In M
	Adithya Nagara		
	1st Cross Road	355.00	7.00
	2nd Cross Road	260.00	6.00
	3rd Cross Road	125.00	4.00
	4th Cross Road	120.00	6.00
	5th Cross Road	155.00	5.50
	6th Cross Road	120.00	6.00
	Cross road A	70.00	5.00
	Cross road B	100.00	5.00
	Cross road C	130.00	5.50
	Cross road D	165.00	5.50
	Cross road E	110.00	5.50
	Cross road F	170.00	5.00
	Cross road G	75.00	5.00
	Cross road H	170.00	5.00
	Balaji Gardenia Layout		
	Main Road	145.00	7.00
	Cross Road 1A	30.00	7.00
	Cross Road 1B	40.00	7.00
	Cross Road 2A	30.00	7.00
	Cross Road 2B	35.00	7.00
	Cross Road 3	30.00	7.00
	Cross Road 4	35.00	7.00
	Total Asphalt Length in m	**2470.00**	
	Avg Width in m		**5.95**

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Restoration and Improvments of balance roads of Chikkabettahalli village and Doddabettahalli Village and Surrounding Areas in Ward no 03 of Yelahanka Satelite town			
S.No	ASPHALT ROAD DETAILS		
	ROAD NAME	ASPHALT ROAD	
		Length in M	Width In M
	New Asphalt Road		
	Maramma temple surroundings		
	cross road A	85.00	6.00
	cross road C	75.00	6.00
	cross road H	30.00	4.50
	cross road I	245.00	6.50
	cross road K	300.00	6.50
	cross road M	245.00	6.50
	Over Head Tank Road	360.00	6.50
	cross road A2	50.00	5.50
	cross road A3	40.00	4.00
	cross road A4	29.00	5.00
	Choudeshwari layout		
	1st cross road	80.00	6.00
	2nd cross road	75.00	6.00
	3rd cross road	80.00	6.50
	4th cross road	70.00	6.50
	M M Layout		
		305.00	6.50
	Total Asphalt Length in m	**2069.00**	
	Avg Width in m		**5.90**

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Restoration and Improvments of balance roads of Adityanagara Phase-01 and Surrounding Areas in Ward no 03 of Yelahanka Satelite town sub division

S.No	RCC DRAIN DETAILS			
	ROAD NAME	RCC DRAIN		
		Sides	Length in m	Total Length
	New RCC Drain			
	New RCC Drain			
1	Shri Venkateshwara Temple Road	2	155.00	310.00
	Balaji Gardenia Layout			
2	Cross Road 1A	2	30.00	60.00
3	Cross Road 1B	2	40.00	80.00
4	Cross Road 2A	2	30.00	60.00
5	Cross Road 2B	2	35.00	70.00
6	Cross Road 3	2	30.00	60.00
7	Cross Road 4	2	35.00	70.00
	Adithya Nagara			
8	1st Cross Road ch87 -ch286 LHS	1	200.00	200.00
9	3rd Cross Road	2	125.00	250.00
10	7th cross road	2	50.00	100.00
11	4th cross road @ end	2	75.00	150.00
	Marammma Temple Surroundings			
12	**cross road A5**	2	26.00	52.00
13	cross road A6	2	50.00	100.00
	New Culvert			
		7	6.00	
		5	7.00	
		Total Drain Length in m		**1562.00**

Restoration and Improvments of balance roads of Chikkabettahalli village and Doddabettahalli Village and Surrounding Areas in Ward no 03 of Yelahanka Satelite town sub division

S.No	RCC DRAIN DETAILS			
	ROAD NAME	RCC DRAIN		
		Sides	Length in m	Total Length
	FOR NEW CC DRAIN			
	Maramma temple surroundings			
1	cross road A	2.00	85.00	170.00
2	cross road C	2.00	75.00	150.00
3	**cross road H**	2.00	30.00	60.00
4	cross road I	1.00	245.00	245.00
5	cross road N	1.00	140.00	140.00
6	cross road O	1.00	40.00	40.00
7	cross road Q	2.00	40.00	80.00
8	cross road V	1.00	30.00	30.00
9	cross road A2	2.00	50.00	100.00
10	**cross road A3**	1.00	40.00	40.00
11	cross road A4	2.00	25.00	50.00

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	Choudeshwari layout			
12	1st cross road	2.00	80.00	160.00
13	**2nd cross road**	2.00	75.00	150.00
14	**3rd cross road**	2.00	80.00	160.00
15	4th cross road	2.00	70.00	140.00
	M M Layout			
	cross road	2.00	305.00	610.00
	New Culvert			
		5.00	6.00	
		4.00	7.00	
		Total Drain Length in m		**2325.00**

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Restoration and Improvments of balance roads of Chikkabettahalli village and Doddabettahalli Village and Surrounding Areas in Ward no 03 of Yelahanka Satelite town sub division

S.No	CONCRETE ROAD DETAILS		
	ROAD NAME	CONCRETE ROAD	
		Length in M	Width In M
	New CC Road		
	Maramma temple surroundings		
	Cross Road N	96.00	4.00
	Cross Road O	40.00	4.00
	Cross Road Q	40.00	4.50
	Cross Road R	30.00	4.00
	Cross Road T	60.00	4.00
	Cross Road U	45.00	4.00
	Cross Road V	30.00	4.00
	Cross Road W	35.00	4.50
	Cross Road X	105.00	3.50
	Cross Road A7	55.00	4.50
	Cross Road A8	50.00	4.00
	Total Asphalt Length in m	**586.00**	
	Avg Width in m		**4.09**

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Restoration and Improvments of balance roads of Adityanagara Phase-01 and Surrounding Areas in Ward no 03 of Yelahanka Satelite town sub division			
S.No	**FOOTPATH WORK DETAILS**		
	ROAD NAME	**FOOTPATH WORK**	
		Length in m	**Width in m**
	New Footpath Details		
	AMS Layout		
1	3rd Main Road	500.00	1.00
		505.00	1.00
2	1st A Cross Road	155.00	1.00
		150.00	1.00
	Total Length in m	**1,310.00**	

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CHAPTER - 5
COST ESTIMATES

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Chapter - 5
COST ESTIMATES

5.1 Detailed Cost Estimate

Detailed cost Estimate has been worked out based on detailed engineering design

5.2 General

Cost Estimate is an important part of the Report as it provides vital input to financial evaluation of the project. The cost estimates have been prepared for Strengthening of the existing road including strengthening of longitudinal drains, road furniture, site clearance and Dismantling.

5.3 Basic rates

As part of Report, Rate Analysis of each of the item has been prepared by adopting PW, P & IWTD SR 2018 – 19, Bangalore Circle. The rates as given in PW, P & IWTD SR are to be enhanced by 6% for additional weightages for the works to be executed under extra ordinary conditions for Bangalore Metropolitan Limits. Items not covered in NHSR / PW, P & IWTD SR have been based on market rates.

5.4 DPR Preparation, Project Management and Quality Control

Provision of 2% of Construction Cost has been made towards DPR Preparation, PMC Charges and third party inspection.

5.5 Project Cost

The total project cost for the proposed work is 1000.00 Lakhs.

Detailed Cost Estimate is enclosed in **Annexure A.5.1**

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CHAPTER - 6
CONCLUSION

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Chapter - 6
CONCLUSION

Restoration and Improvments of balance roads of Adhityanagara Phase-01 , Chikkabettahalli village and Doddabettahalli Village and Surrounding Areas in Ward no 03 of Yelahanka Satelite town sub division. The Project area is located near Adithya nagar of Bangalore City. Major attractions along the stretch are Adhitya Nagara, Balaji Gardenia Layout, Shri Venkateshwara Temple Road, Ashwathkatte Road, MM Layout Road, Marammma Temple Surroundings. The Stretch provides vidal connectivity in Adhityanagara and Surrounding Area.The spurt in the development of Bangalore City with creation of ITPL, Tech Parks, Layouts, and Education Institutions has resulted in change of the Land Use Pattern. Further, Bruhat Bangalore Mahanagara Palike has decided to take up the development of various Arterial and Sub Arterial roads in and around Bangalore City where the intensity of traffic has increased significantly and there is a requirement for augmentation of capacity for safe and efficient movement of traffic. This being the Background, Bruhath Bangalore Mahanagara Palike has proposed for the following works in order to provide Seamless Traffic Flow and to Increase Level of Service along the Project Stretch.

For the proposed Improvement Scheme, total Cost of the Project has been worked out as Rs. 1000.00 Lakhs

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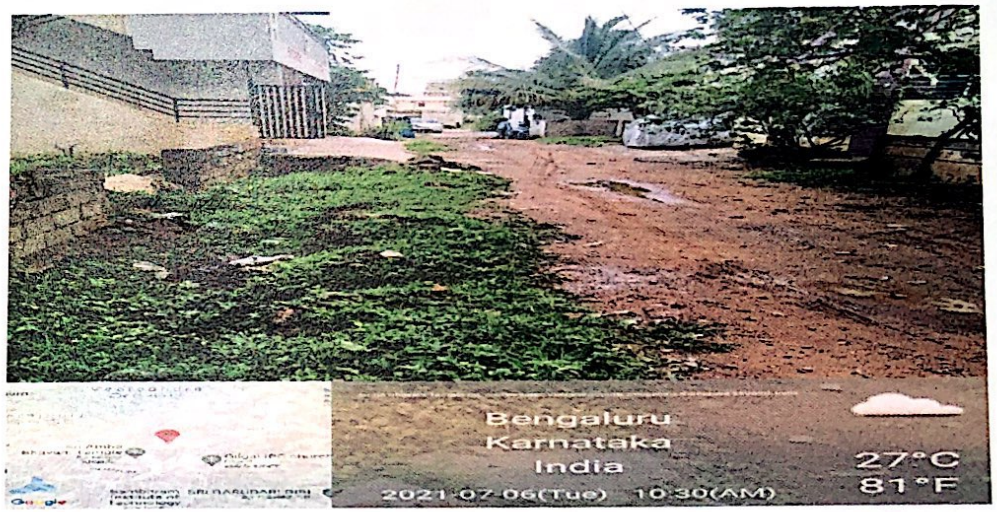

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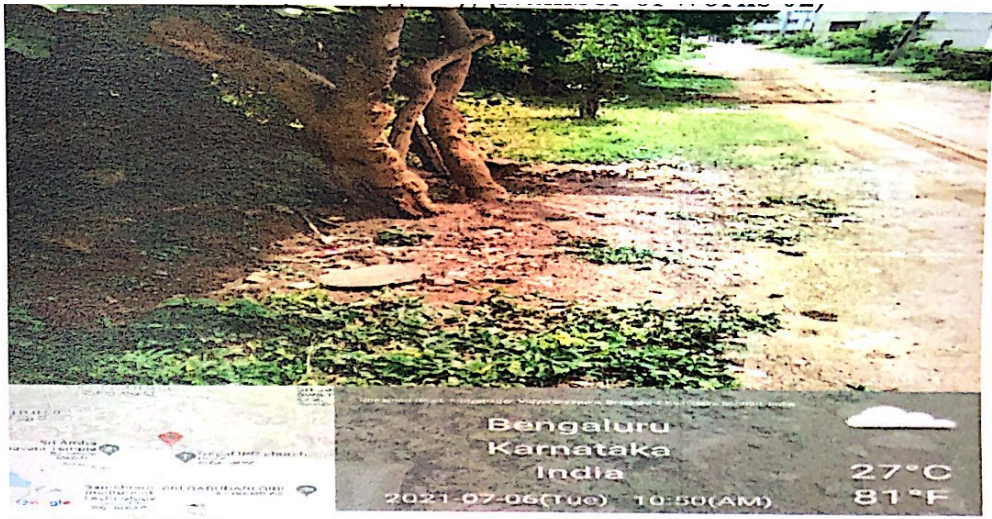

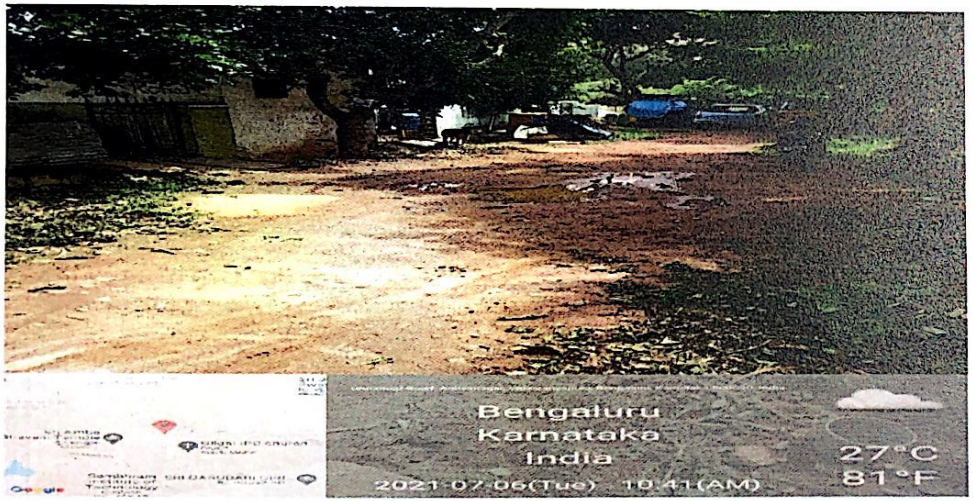

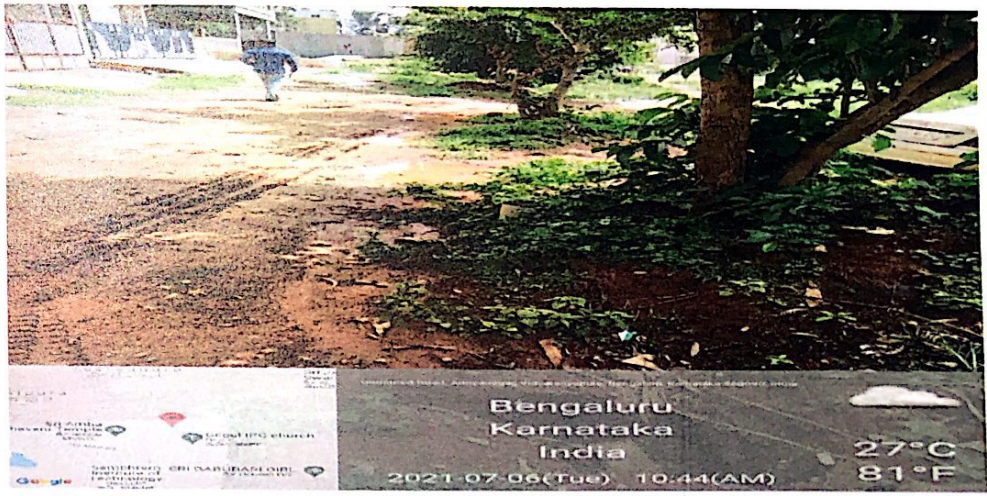

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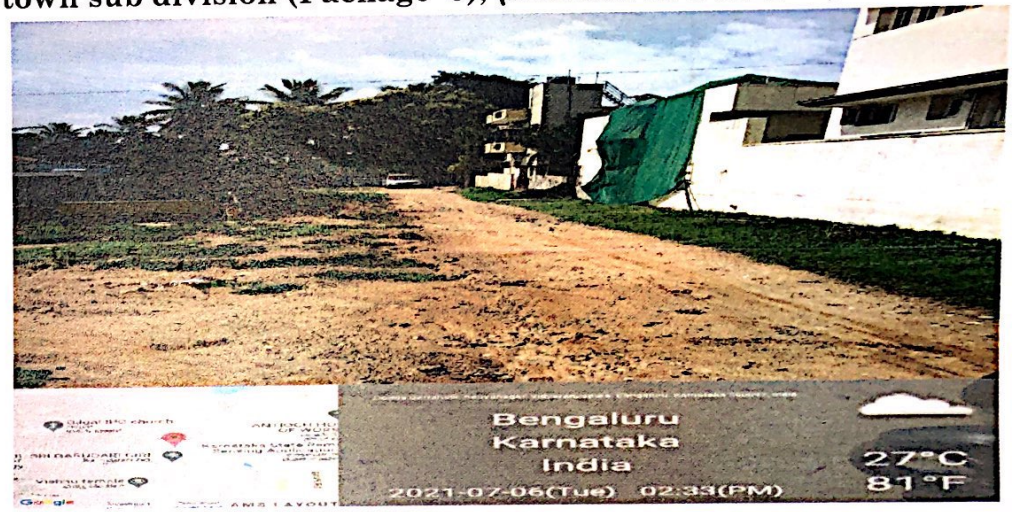
Restoration and Improvements of balance roads of Chikkabettahalli village Doddabettahalli Village Adityanagara Phase-01 and Surrounding Areas in Ward no 03 of Yelahanka New town sub division (Package -5), (Number of Works 02)



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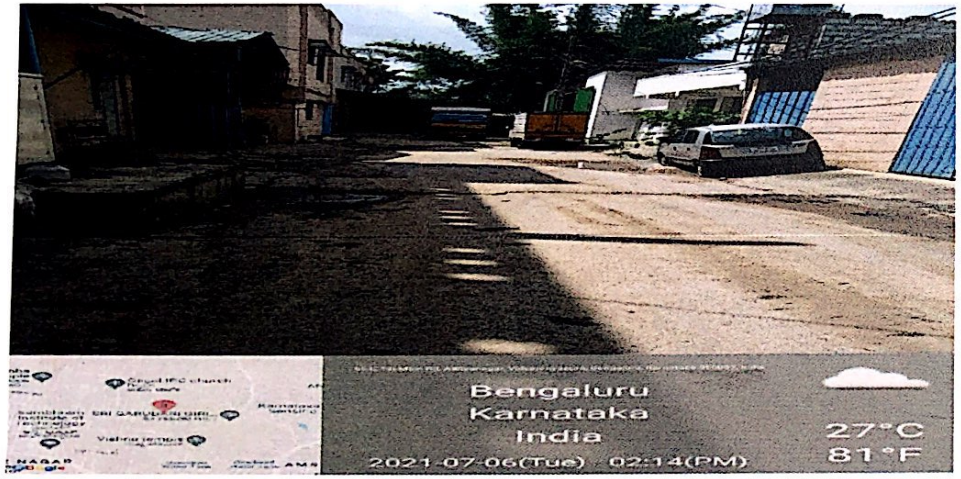

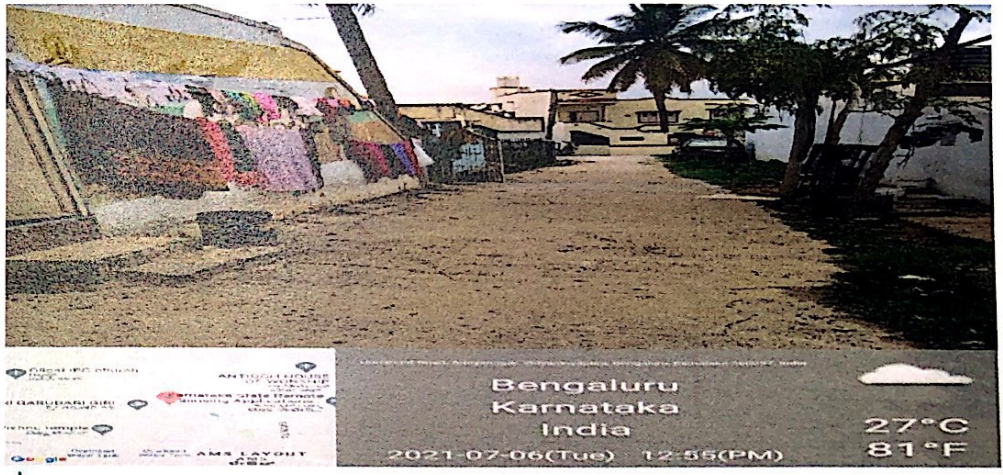

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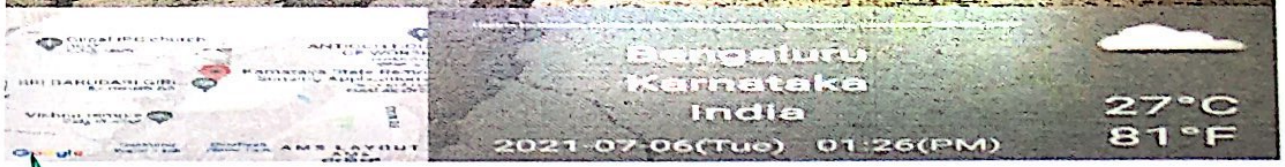

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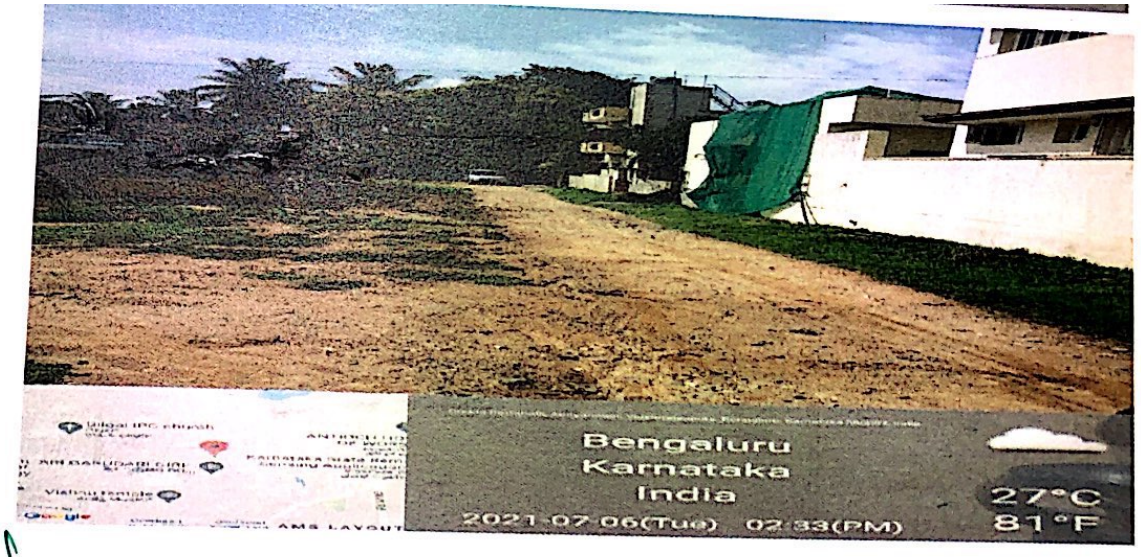

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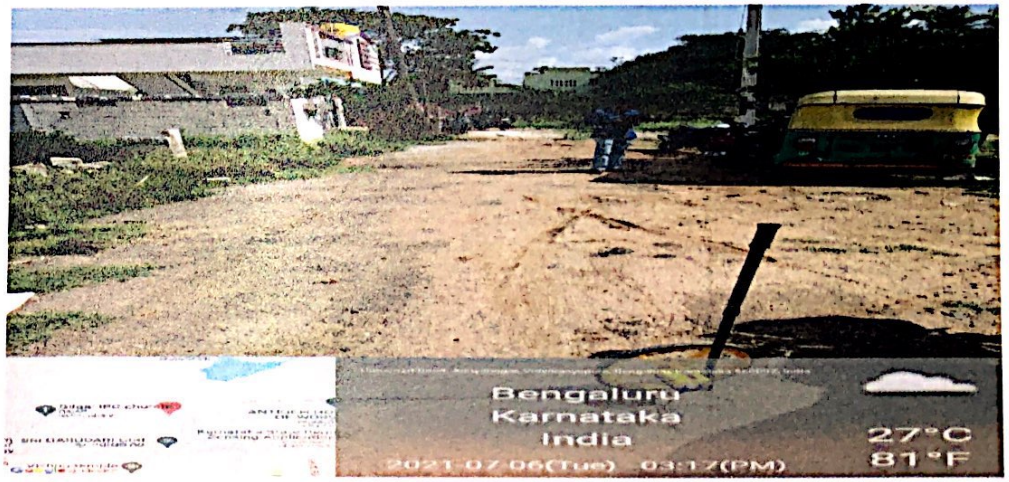

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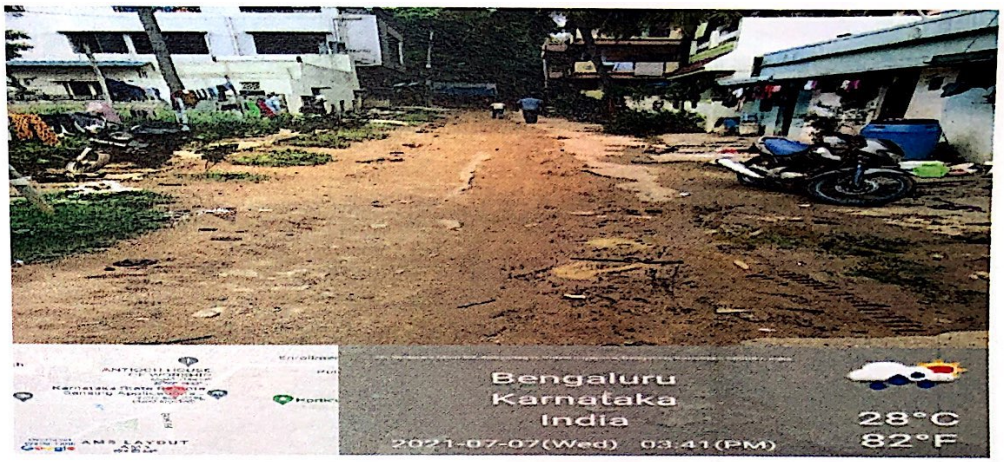

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